GROUP 2

1. Group 2 metals and oxygen

Generally, the Group 2 metals burn in oxygen to form a metal oxide.

●Beryllium is coated in a thin layer of beryllium oxide which inhibits the reaction meaning it only reacts in a powder form. $2Be + O_2 \rightarrow 2BeO$

● Magnesium burns in oxygen with a bright white flame. $2Mg + O_2 \rightarrow 2MgO$

● Calcium burns with a bright white flame which is slightly red at the top. $2Ca + O_2 \rightarrow 2CaO$

● Strontium is reluctant to start burning but burns intensely with a white flame. $2Sr + O_2 \rightarrow 2SrO$

● Barium burns in oxygen with white flame. $2Ba + O_2 \rightarrow 2BaO$

2. Group 2 metals and water

The reactions of the Group 2 metals with water or steam can be used to see the trend in reactivity down the group.

● Beryllium reacts with steam only at very high temperatures. $Be + H_2O \rightarrow BeO + H_2$

● Magnesium has a very slight reaction with cold water. The reaction stops due to the production of an insoluble coat of magnesium hydroxide. $Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$

Magnesium burns in steam more readily than cold water: $Mg + H_2O \rightarrow MgO + H_2$

● Calcium, strontium and barium all react in cold water to produce their hydroxide and hydrogen gas. The reactions become increasingly vigorous down the group. E.g. $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

Going down Group 2, the metals react more readily and rapidly with cold water, with barium reacting the fastest. This shows that reactivity increases down the group.

3. Group 2 metals and dilute acids

All Group 2 metals react with dilute hydrochloric acid to produce a metal chloride and hydrogen gas. The reactions get more vigorous as you go down the group.

- The general equation for this reaction is: $X + 2HCl \rightarrow XCl_2 + H_2$ (where X is a Group 2 metal).

Dilute sulfuric acid reacts with Group 2 metals to produce a metal sulfate and hydrogen. The reactions with dilute sulfuric acid do not get more vigorous down the group due to the solubility of the sulfates produced.

- The general equation for this reaction is: $X + H_2SO_4 \rightarrow XSO_4 + H_2$ (where X is a Group 2 metal.)

4. Group 2 oxides

Reactions with water

Apart from beryllium, all Group 2 oxides react with water to produce hydroxides.

XO + H2O → X(OH)2

Reactions with dilute acids

All Group 2 oxides react with dilute acids to produce salt and water.

The general equations for these reactions (where X is a group 2 metal) are:

- XO + 2HCl → XCl2 + H2O
- XO + 2HNO3 → X(NO3)2 + H2O
- XO + H2SO4 → XSO4 + H2O

5. Group 2 hydroxides

Reactions with water

The Group 2 hydroxides do not react with water.

Reactions with dilute acids

The Group 2 hydroxides react with dilute acids in the same way as the metal oxides. The only difference is that two water molecules are produced. E.g. Sr(OH)2 + 2HCl → SrCl2 + 2H2O

6. Metal carbonates

Reactions with water

The Group 2 metal carbonates are insoluble so they do not react with water.

Reactions with dilute acids

Group 2 carbonates react with dilute acids to produce a salt, water and carbon dioxide.

The general equations for these reactions (where X is a Group 2 metal) are:

- XCO3 + 2HCl → XCl2 + H2O + CO2
- XCO3 + 2HNO3 → X(NO3)2 + H2O + CO2
- XCO3 + H2SO4 → XSO4 + H2O + CO2

7. Thermal decomposition of the nitrates and carbonates

Nitrates

All Group 2 nitrates undergo thermal decomposition to produce a metal oxide, oxygen and nitrogen dioxide.

The general equation for this reaction is: $2X(NO_3)_2 \rightarrow 2XO + 4NO_2 + O_2$

Observations: The nitrate and the oxide are both white solids. Nitrogen dioxide is a brown gas.

Carbonates

All Group 2 carbonates undergo thermal decomposition to produce a metal oxide and carbon dioxide.

The general equation for this reaction (where X is the Group 2 metal) is: $XCO_3 \rightarrow XO + CO_2$

Observations: The carbonate and the oxide are both white solids. Carbon dioxide is a colourless gas.

Both Group 2 carbonates and nitrates become more stable to heat as you go down the group. This means as you go down the group, the nitrates and carbonates have to be heated more strongly for thermal decomposition to occur.

8. Predicting trends

The reactions of Group 2 metals, metal oxides, metal hydroxides and metal carbonates generally indicate that reactivity increases as you go down Group 2.

Reactivity increases down the group because ionisation energy decreases due to the increasing atomic radius and the shielding effect of electrons.

This means further down the group, the electrons become easier to remove so reactivity increases.

The solubilities of the Group 2 metal hydroxides and sulfates: the solubility of group 2 hydroxides increase down the group, but the solubility of group 2 sulfates decrease down the group.

9. Uses of Group 2 compounds

Calcium hydroxide and calcium carbonate are both compounds used in agriculture.

Calcium carbonate is powdered limestone.

Calcium hydroxide is formed when calcium oxide is added to water. Calcium oxide and calcium hydroxide are often referred to as lime and slaked lime, which are alkaline. When the soil is too acidic, calcium hydroxide is added to bring the pH to 6, which is the best condition for crops to grow.